BANGOR HYDRO-ELECTRIC COMPANY

PROFILING METHODOLOGY

FEBRUARY 1, 2000

This report details the methodology Bangor Hydro-Electric Company will employ to estimate the hourly loads of Competitive and Standard Offer Providers supplying energy within its territory after retail competition begins on March 1, 2000.

BACKGROUND

In order for ISO-NE to settle the electricity markets in New England each day, ISO-NE must be able to assign load responsibility to the various suppliers. Local Distribution Utilities have been deemed to be in the best position to determine the hourly loads of Suppliers operating within their territories.

For customers with loads of sufficient magnitude to justify the expense of daily polling of their meters, actual loads are able to be determined. In order for other customers to participate in retail choice, their hourly loads must be estimated via Load Profiling.

CHOICE OF PROFILING METHODOLOGY

Bangor Hydro-Electric, Central Maine Power, Maine Public Service, and the MPUC agreed that the utilities would use the same load profiling methodology for the three profile groups defined in Chapter 321. Each utility will generate static profiles that represent a typical weekday or typical weekend day for each month of the year for each of the three profile groups. Holidays will be modeled using a weekend profile.

The typical day profiling approach is both straightforward and predictable. Use of this method helps ease the transition into the competitive market for both Bangor Hydro and suppliers. However, other methods of profiling are available. Although the typical day profiling methodology will be used for the first year of retail competition, other methodology types will be investigated. The MPUC requires that the Maine utilities file a report by June of 2000 that will contain the results of this investigation. Any recommended changes in profiling methodology or profile groups would become effective March 1, 2001.

BUILDING PROFILES

The three profiles will be built using a software tool called Load Vision (ICF Consulting Group, Inc). Load Vision is a load estimation, settlement, and imbalance pricing system. It calculates estimated hourly loads for a given population of customers and their energy suppliers. Load Vision estimates the loads of each customer individually, either by applying profiles that it creates or by accepting actual loads from interval metered customers.

Interval data from participants in the three load research studies will be processed within MV-90, a meter data translation software system. Each non-normal interval has an associated status code. When the interval data files are sent to Load Vision, these status codes dictate whether the non-normal intervals are used in the calculation of average hourly loads. It is in this way, for example, that Load Vision can distinguish between a legitimate zero usage interval and one resulting from a power outage or data overflow. Files are sent to Load Vision in EU format for each sample point once a month. Data will be exported to Load Vision in 60-minute format.

A number of steps are involved in building profiles within Load Vision. See Appendix A for an explanation of these procedures.

ESTIMATION OF LOADS

Chapter 321 (MPUC) requires that all customers of Bangor Hydro with demands of 500 kW or greater must be telemetered. In addition, a supplier may request that any of its customers be telemetered rather than have a load profile applied.

Bangor Hydro will poll each telemetered customer's meter at some point after midnight and before 6 a.m. each day. Actual hourly loads for the previous day will be collected. These actual loads, with the addition of appropriate losses, will be assigned to the customer's Supplier. Polling of the meters will be performed by MV-90.

Actual data may not be available due to problems with remote meter reading equipment or meter malfunctions. In these instances, Load Vision will estimate data based on individual profiles. Each interval customer will have individualized load profiles created which will be based solely on that customer's own historic usage. In the event of missing data, gaps will be filled by applying these individual curves. Later, if the data becomes available, the estimated data will be replaced by actual. This approach allows the estimate to be based on the customer's actual historical load, not a class profile.

For non-metered loads, such as street and area lighting, a deemed profile is applied which is based on the number of hours of darkness occurring each day. All other non-interval metered Bangor Hydro customers are assigned to one of the three profile groups. Estimating customer loads with profiles is performed in two steps. First, a usage factor is calculated for each customer for the time period for which loads are to be estimated. A usage factor is the kWh consumed by a customer for a given period of time divided by the kWh for the profile to which the customer is assigned over the same period. Next, the usage factor is applied to the profile to which the customer is assigned. Each customer's kWh usage is spread across the time period to be estimated by multiplying the usage factor by the hourly profile values.

Each of the three Maine electric utilities – Bangor Hydro, Central Maine Power, and Maine Public Service – are employing the same profiling methodology and the same estimation software tool. For a detailed explanation of how Load Vision performs the estimation process, see CMP's December 1, 1999 methodology report. The relevant

section is attached to this document as Appendix B, which also contains an explanation of the month-end adjustment procedure.

REPORTING

Bangor Hydro will transmit estimated hourly loads to ISO-NE by Load Asset ID within 37 hours after the estimated day ends. At the same time, Bangor Hydro will send to each supplier its own estimated loads, again by Asset ID. The month-end adjusted figures will be reported within 90 days of the end of the month. ISO-NE will receive a revised total Megawatt figure, while suppliers will receive revised hourly numbers.

SUMMARY

Bangor Hydro-Electric Company will estimate the hourly loads of all suppliers operating within its service territory after retail competition begins on March 1, 2000. It will do so via a methodology which combines collecting actual load data from interval metered customers and by applying profiles adjusted by energy usage factors for all other customers.

Appendix A

This appendix contains an explanation of the Typical Day methodology and was prepared by Load Vision's developer, ICF Consulting of Fairfax, Va. The examples shown accurately reflect the process to be followed by Bangor Hydro except that in Maine each utility will create two profiles per month – one for weekdays and one for weekends/holidays.

Day Type Methodology

The Day Type technique produces a series of typical season/day-type profiles from historical interval data. To create a day-type profile, the user first selects the Day Type as the Load Shape Representation on the Options for Creating Load Profile window. Once the user has selected the Day Type representation type and defined the desired season/day types a load profile is created for each season/day-type.

To view the profiles, the user clicks on the View Profile button on the Select Segment for Load Profile Analysis window. The Representation Viewer window will open and a Load Shape Libraries file folder will be visible. When the user clicks on the folder, or on the small box beside it, the folder will open, and the associated season/day-types book icons will appear. To view the profile for a specific season/day type the user clicks on the book icon associated with the season/day type. The book will open, and the graph will be displayed in the workspace. The twenty-four hours for the profile are plotted on the horizontal axis and the associated loads are plotted on the vertical axis as a bold line. The weighted average of the actual interval data points used to create the profile are plotted as thin lines. The colors of the profile graph and the actual interval data graphs can be adjusted on the Graph tab of the Load Vision Settings.

Given sets of 24 hour loads for each day of the year defined in the calendar, the next step toward computing a 24 hour load shape for each set of days defined in the first step is to average the hourly loads in chronological order. That is, the loads in each day's first hour are averaged to determine a first hour average load. Then the loads in each day's second hour are averaged, and so forth until the loads in all 24 hours are averaged. The result of this process is an average daily load shape.

Although the average daily load shape may indicate the hour in which the average peak occurs, and the average trough it also results in a flattened load shape. Therefore, this average load shape's peak is generally too low, and trough is generally too high. That is due to the fact that the peaks and troughs do not occur in the same hour in each day of the averaged set of days. This flattening result is applicable to all hours of the average daily load shape. Therefore, this average daily load shape can be used to indicate the ordering of the hours based upon load magnitude, but not the absolute load in each hour.

1.1.1.1.1 Methodology

Step 1: Group loads based on season/day-type combination.

The user will define the season and day-type structure to be used. The load values will be grouped into one of the 12 bins. Holidays will be put into the Sunday bin in this example.

Example:

4 Season/3 Day-Type

Season 1 (Winter): Dec, Jan, Feb
Season 2 (Spring): Mar, Apr, May
Season 3 (Summer): Jun, Jul, Aug
Season 4 (Autumn): Sep, Oct, Nov

Day-Type 1 (Weekday): Mon, Tue, Wed, Thurs, Fri
Day-Type 2 (Saturday): Sat
Day-Type 3 (Sunday): Sun

Step 2: Create a weighted average of all observations for the profile for each day.

- Get list of StudyIDs and weights from the Segment_Weights table for the profile.
- Get actual observations from the .Interval file for the StudyIDs listed in the Segment_Weights table.
- Create the weighted observation (2 options).

Example:

Weights from Segment_Weights table:

Segment	StudyID	Weight
RES	123	1
RES	456	1
RES	789	1

Actual Observations from the .Interval File:

StudyID	Day	Hour 1	Hour 2	Hour 3	Hour4	…
123	12/1/98	30	50	40	60	…
456	12/1/98	35	55	45	65	…
789	12/1/98	40	60	50	70	…

Weighted Observations:

Option 1: Divide by the Sum of Weights

WL (p,s,d,h) = Σ (L (p,s,d,h) * W (p)) / Σ W (p)

Where:
WL (p,s,d,h) = Weighted load for the profile (p), season (s), day-type (d), and hour (h)
L (p,s,d,h) = Load for the profile (p), season (s), day-type (d), and hour (h)
W (p) = Weight for the profile (p)

Option 2: Don't Divide by the Sum of Weights

WL (p,s,d,h) = Σ (L (p,s,d,h) * W (p))

Where:
WL (p,s,d,h) = Weighted load for the profile (p), season (s), day-type (d), and hour (h)
L (p,s,d,h) = Load for the profile (p), season (s), day-type (d), and hour (h)
W (p) = Weight for the profile (p)
Result (this is what will be seen graphically when looking at the profile data)

Segment	Day	Hour 1	Hour 2	Hour3	Hour4	…
RES	12/1/98	35	55	45	65	…
RES	12/2/98	60	70	50	55	…
RES	12/3/98	55	70	55	60	…
RES	12/4/98	32	60	45	50	…

Step 3: Average the load values to create an Average Load Shape

ALS (p,s,d,h) = Σ L (s,d,h) / # observations

Where:
ALS (s,d,h) = Average load shape for the season (s) , day-type (d), and hour (h).
L (s,d,h) = Load for the season (s) , day-type (d), and hour (h).
S = season
D = day-type
H = hour
#observations = number of days in the observation for the season (s) , day-type (d), and hour (h).

Season 1, Day-Type 1

Segment	Day	Hour 1	Hour 2	Hour3	Hour4	…
RES	12/1/9	35	55	45	65	…

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RES	12/2/98	60	70	50	55	…
RES	12/3/98	55	70	55	60	…
RES	12/4/98	32	60	45	50	…

Result:

Segment	Day-Type	Hour 1	Hour2	Hour 3	Hour 4	…
RES	Weekday	45.5	63.75	48.75	57.5	…

Step 4: Sort the load values in descending order to create a Load Duration Curve

Example:

Season 1, Day-Type 1

Segment	Day	Hour1	Hour2	Hour3	Hour4	…
RES	12/1/98	65	55	45	35	…
RES	12/2/98	70	60	55	50	…
RES	12/3/98	70	60	55	55	…
RES	12/4/98	60	50	45	32	…

Step 5: Average the Load Duration Curve values to create an Average Load Duration Curve

ALDC (s,d,h) = Σ h / # observations

Where:
ALS (s,d,h) = Average load duration curve for the season (s) , day-type (d), and hour (h).
S = season
D = day-type
H = hour
#observations = number of days in the observation for the season (s) , day-type (d), and hour (h).

Example:

Result:

Segment	Day-Type	Hour 1	Hour2	Hour 3	Hour 4	…
RES	Weekday	66.25.	56.25	50	43	…

Step 6: Map the Average Load Shape to the Average Load Duration Curve

Example:

Average Load Shape:

Segment	Day-Type	Hour 1	Hour2	Hour 3	Hour 4	…
RES	Weekday	45.5	63.75	48.75	57.5	…

Average Load Duration Curve:

Segment	Day-Type	Hour 1	Hour2	Hour 3	Hour 4	…
RES	Weekday	66.25	56.25	50	43	…

Result (black line):

Segment	Day-Type	Hour 1	Hour2	Hour 3	Hour 4	…
RES	Weekday	63.75	57.5	48.75	45.5	…

APPENDIX B

The following is an excerpt from Central Maine Power Company's December 1, 1999 Methodology Report filed with the Maine Public Utility Commission. It contains an explanation of how Load Vision performs load estimation. Because each of the three Maine electric utilities will be using Load Vision, the process that this appendix details is applicable to all.

ESTIMATION OF DAILY LOAD

The daily estimation process begins by loading various types of data into Load Vision. The data loading is an automated process and includes system load data, weather data, telemetered load data, load research sample data, account administration data (supplier enrollments and drops) and billing data. Customer meters are read in cycles throughout the month. CMP has 20 cycles; so, approximately $1/20^{th}$ of all customers will have billing data loaded into Load Vision after each billing cycle. Load research sample data is read on the sampled customer's cycle meter reading. Thus, load research data will be loaded into Load Vision as it becomes available throughout the month.

Once CMP verifies that all available data loaded correctly (using Load Vision's log files), the next step is to calculate the daily load estimate for each supplier. Estimating hourly loads can be more easily understood by seeing the actual calculations Load Vision performs. ICF Consulting, Inc., prepared a description of supplier hourly load calculations. The following steps are based on their documentation, modified to reflect CMP terminology.

The load estimation process can be broken down into four major steps:

- Profiled Load Estimation
- Telemetered Load Determination
- Aggregation of Hourly Loads by Supplier
- Reconciliation of Supplier Hourly Loads

PROFILED LOAD DETERMINATION

Step 1. Determine an hourly profiled load for each customer profile class. A static profile will be used for each of the three profile classes defined in Chapter 321 and a deemed profile will be used for unmetered load.

Step 2. Scale the profiled load by the relevant Loss Factor. The loss factor is assigned to the customer depending on the season and voltage level.

Loss-adjusted Profile Load for customer i by hour h	=	**Profile Load** for customer i by profile class by hour h	**x**	**Loss Factor** for customer i by loss class s

Step 3. Determine each customer's Usage Factor. The Usage Factor (UF) characterizes how the customer's usage relates to the average usage for their profile class. It is defined as the ratio of the metered usage to the aggregate hourly profiled loads for the customer's profile class for a billing period. If a new customer has no historic or billed usage, an hourly Usage Factor of 1.0 will be assigned to that customer.

Usage Factor for customer i by profile class p	=	$\frac{\textbf{Metered Usage for Billing Period i}}{\textbf{Profile Load for Billing period i,p}}$ where Profile Load for Billing Period is the sum of hourly profile loads for the billing period by profile class p assigned to customer i

Step 4. Derive the usage-adjusted profile load for each customer. The usage-adjusted profile is the loss-adjusted profile from Step 2 multiplied by the customer Usage Factor from Step 3.

Usage-Adjusted Profile Load for customer i by hour h	=	**Loss-Adjusted Profile Load** for customer i by profile class p and hour h	**x**	**Usage Factor** for customer i by profile class p

TELEMETERED LOAD DETERMINATION

For a telemetered customer, if interval meter data is available for the day being estimated, the hourly load is the metered usage multiplied by the customer's Loss Factor. The Loss Factor assigned to the customer depends on the season and voltage level.

Hourly Telemetered Load for customer i by hour h	=	**Metered Hourly Usage** for customer i by hour h	x	**Loss Factor** for customer i by loss class

If a telemetered customer's interval data is not available for the day being estimated, the missing data will be estimated using the customer's historical usage and a proxy day profile. The hourly loads using the proxy day profile will be calculated using the method for profiled load detailed above.

AGGREGATION OF HOURLY LOADS BY SUPPLIER

This step aggregates customer hourly loads created in the previous procedures into total loads for each supplier.

Supplier Hourly Load for Supplier S for hour h	=	*Sum* i	**(Hourly Telemetered Load)** for customer i assigned to Supplier S by hour h	+ *Sum* i	**(Hourly Profiled Load)** for customer i assigned to Supplier S by hour h

RECONCILIATION OF SUPPLIER HOURLY LOADS

The reconciliation process is conducted in five steps:

- Determine the difference between the known metered system load and total estimated hourly load
- Determine each Supplier's total profile load
- Calculate each Supplier's profile Load Allocation Ratio
- Allocate the Difference to the supplier's non-telemetered customers using the Load Allocation Ratio, thereby deriving each Supplier's reconciled profile load
- Calculate the Supplier's Hourly Load Obligation as the sum of each supplier's reconciled profile load and telemetered load.

Step 1. Determine the Hourly Load Difference using the hourly system load as the baseline.

Hourly Load Difference	=	Actual Hourly System Load	-	Estimated Hourly Load
by hour h		for hour h		for hour h

Note: The Estimated Hourly Load is the sum of all Supplier Hourly Loads calculated earlier

Step 2. Determine the Supplier profile load. Allocating the Hourly Load Difference to profiled customers only requires that all telemetered loads for a Supplier be subtracted from that Supplier's total hourly load. The resulting value is the Supplier's hourly profile load.

Supplier Hourly Profile Load	=	Supplier Hourly Load	-	Total Hourly Telemetered Load
for Supplier S for hour h		for Supplier S by hour h		for Supplier S by hour h

Step 3. Calculate the Load Allocation Ratio. The Hourly Load Difference from Step 1 is allocated to a Supplier based on the ratio of the Supplier's profile load to the aggregate profile load of all Suppliers.

Load Allocation Ratio	=	Supplier Hourly Profile Load	/*Sum* S	(Total Hourly Profile Load)
for Supplier S for hour h		for Supplier S by hour h		for Supplier S by hour h

Step 4. Allocate the Hourly Load Difference to the Supplier's non-telemetered customers. This reconciliation step distributes the Hourly Load Difference back to the non-telemetered customers using the Load Allocation Ratio. The allocated amount is the product of the Hourly Load Difference and the Load Allocation Ratio. This allocation amount is added to the Supplier's hourly profile load from Step 2 to derive the Reconciled Profile Load.

Reconciled Profile Load =
for Supplier S
for hour h

Supplier Hourly Profile Load	+	(Hourly Load Difference	x	Load Allocation Ratio)
for Supplier S for hour h		for Supplier S for hour h		for Supplier S for hour h

Step 5. Calculate the Supplier Hourly Load Obligation. The Supplier Hourly Load Obligation is the sum of the Supplier's hourly telemetered load and the reconciled profile load from Step 4.

Supplier Hourly Load Obligation = for Supplier S for hour h

Supplier Hourly Telemetered Load for Supplier S for hour h + **Reconciled Profile Load** for Supplier S for hour h

MONTH-END ADJUSTMENTS

After all meter readings for each month have been obtained, CMP will re-estimate the hourly load for the month. The process will be identical to the daily process but the month-end calculation will use available data collected subsequent to the original calculation. The usage factors will be recalculated to reflect each customer's most recent billing period's usage. This usage will better reflect usage during the month being re-estimated. The calculations for the month-end adjustment are the same as described in the daily process: total profiled load with losses is added to total telemetered load with losses and compared to total system load. Any hourly differences are allocated back to suppliers based on their proportion of the total profiled load.